

## General

### Guideline Title

Evidence-based guidelines for the management of large hemispheric infarction: a statement for health care professionals from the Neurocritical Care Society and the German Society for Neuro-Intensive Care and Emergency Medicine.

### Bibliographic Source(s)

Torbey MT, BÃ¶lssel J, Rhoney DH, Rincon F, Staykov D, Amar AP, Varelas PN, JÃ¼ttler E, Olson D, Huttner HB, Zweckberger K, Sheth KN, Dohmen C, Brambrink AM, Mayer SA, Zaidat OO, Hacke W, Schwab S. Evidence-based guidelines for the management of large hemispheric infarction: a statement for health care professionals from the Neurocritical Care Society and the German Society for Neuro-intensive Care and Emergency Medicine. *Neurocrit Care*. 2015 Feb;22(1):146-64. [172 references]  
[PubMed](#)

### Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

## Recommendations

### Major Recommendations

Definitions of the strength of recommendations (*strong, weak*) and quality of the evidence (*high, moderate, low, very low*) are provided at the end of the "Major Recommendations" field.

#### Airway Management

- What are the indications for intubation and extubation in large hemispheric infarction (LHI)?
- What is the best timing for tracheostomy in LHI?

#### Recommendations

LHI patients with signs of respiratory insufficiency or neurological deterioration should be intubated immediately (*strong recommendation, very low quality of evidence*).

Extubation should be attempted in LHI patients who meet the following criteria, even if communication and cooperation cannot be established (*strong recommendation, very low quality of evidence*):

- Successful spontaneous breathing trials

- Absence of oropharyngeal saliva collections
- Absence of demand for frequent suctioning
- Presence of cough reflex and tube intolerance
- Free of analgesia and sedation

Tracheostomy should be considered in LHI patients failing extubation or in whom extubation is not feasible by 7 to 14 days from intubation (*weak recommendation, low quality of evidence*).

### Hyperventilation

Does hyperventilation effectively treat increased intracranial pressure (ICP) in LHI?

#### Recommendations

The authors recommend against prophylactic hyperventilation in LHI patients (*strong recommendation, very low quality of evidence*).

The authors suggest using hyperventilation for short period of time as a rescue maneuver in LHI patients showing clinical signs of brain herniation (*weak recommendation, very low quality of evidence*).

### Analgesia and Sedation

Should analgesia and/or sedation be administered in LHI patients? If so, which pharmacologic agents should be used?

Are daily wake-up trials recommended?

#### Recommendations

The authors recommend analgesia and sedation if signs of pain, anxiety, or agitation arise in LHI patients (*strong recommendation, very low quality of evidence*).

The authors recommend the lowest possible sedation intensity and earliest possible sedation cessation, while avoiding physiologic instability and discomfort in LHI patients (*strong recommendation, very low quality of evidence*).

The authors recommend against the routine use of daily wake-up trials in LHI patients. Caution is particularly warranted in patients prone to ICP crises. Neuromonitoring of at least ICP and cerebral perfusion pressure (CPP) is recommended to guide sedation, and daily wake-up trials should be abandoned or postponed at signs of physiological compromise or discomfort (*strong recommendation, very low quality of evidence*).

### Gastrointestinal Tract

How should dysphagia be assessed in LHI patients?

When should LHI patients receive a nasogastric tube?

When should LHI patients receive a percutaneous enterogastric tube?

#### Recommendations

The authors suggest dysphagia screening in the early phase of LHI. Dysphagia can be assessed once the patient is weaned from sedation and ventilation (*weak recommendation, very low quality of evidence*).

LHI patients with dysphagia should receive a nasogastric tube as soon as possible (*weak recommendation, very low quality of evidence*).

The authors suggest that high National Institute of Health Stroke Scale (NIHSS) scores and persisting dysphagia on endoscopic swallowing should prompt discussion with the family on placement of a percutaneous endoscopic gastrostomy (PEG) tube between weeks 1 and 3 of the intensive care unit (ICU) stay (*weak recommendation, very low quality of evidence*).

### Glucose Control

How should glucose be controlled in LHI patients?

## Recommendations

The authors recommend that hypoglycemia and hyperglycemia should be avoided in LHI. Intermediate glycemic control (serum glucose level 140–180 mg/dL) should be the target of insulin therapy in LHI patients (*strong recommendation, very low quality of evidence*). The authors recommend that intravenous sugar solutions should be avoided in LHI (*strong recommendation, very low quality of evidence*).

## Hemoglobin Control

What is the optimal hemoglobin level in LHI patients?

## Recommendations

The authors recommend maintaining a hemoglobin of 7 g/dL or higher in LHI patients (*strong recommendation, very low quality of evidence*). Clinicians should also consider specific situations such as planned surgery, hemodynamic status, cardiac ischemia, active significant bleeding, and arteriovenous oxygen extraction compromise when determining the ideal hemoglobin for a patient (*weak recommendation, very low quality of evidence*). Consider reducing blood sampling wherever possible in order to decrease the risk of anemia in LHI (*weak recommendation, very low quality of evidence*).

## Deep Venous Thrombosis Prophylaxis

How should deep venous thrombosis (DVT) prophylaxis be administered to LHI patients?

## Recommendations

The authors recommend early mobilization to prevent DVT in hemodynamically stable LHI patients with no evidence of increased ICP (*strong recommendation, very low quality of evidence*). The authors recommend DVT prophylaxis for all LHI patients upon admission to the ICU and for the duration of immobilization (*strong recommendation, very low quality of evidence*). The authors recommend using intermittent pneumatic compression (IPC) for DVT prophylaxis (*strong recommendation, moderate quality of evidence*). The authors recommend using low molecular weight heparin (LMWH) for DVT prophylaxis (*strong recommendation, low quality of evidence*). The authors recommend against the use of compression stockings for DVT prophylaxis (*strong recommendation, moderate quality of evidence*).

## Anticoagulation

If LHI is due to a cardioembolic mechanism or if the patient has high thromboembolic risk, when should anticoagulation be initiated after LHI?

## Recommendations

The authors suggest that oral anticoagulation be reinitiated 2 to 4 weeks after LHI in patients at high thromboembolic risk (*weak recommendation, very low quality of evidence*). The authors suggest that earlier re-initiation of oral anticoagulation should be based on clinical risk assessment and additional diagnostic tests (e.g., prosthetic valve, acute DVT, acute pulmonary embolism (PE), or transesophageal echocardiography (TEE) showing intracardiac thrombus) (*weak recommendation, very low quality of evidence*). The authors suggest using aspirin during the period of no anticoagulation in LHI with atrial fibrillation (AF) or increased thromboembolic risk, provided surgery is not imminent (*weak recommendation, very low quality of evidence*).

## Blood Pressure Management

What is the optimal blood pressure in LHI patients?

#### Recommendations

The authors recommend that clinicians follow current blood pressure management guidelines for ischemic stroke in general when caring for LHI patients. Maintain a mean arterial pressure (MAP) >85 mm Hg in ischemic stroke without hemorrhagic transformation. Lower systolic blood pressure (SBP) to <220 mm Hg (*strong recommendation, low quality of evidence*).

The authors suggest avoiding blood pressure variability, especially in the early phase of LHI treatment (*weak recommendation, low quality of evidence*).

#### Steroid Therapy

Do steroids effectively reduce brain edema in LHI?

#### Recommendation

The authors recommend against using steroids for brain edema in patients with LHI (*strong recommendation, low quality of evidence*).

#### Barbiturate Therapy

Do barbiturates effectively treat brain edema in LHI?

#### Recommendation

Barbiturate therapy is not recommended in patients with LHI because the risks outweigh the benefits (*strong recommendation, low quality of evidence*).

#### Temperature Control

Does hypothermia or normothermia have any role in the management of brain edema after LHI?

#### Recommendations

The authors suggest considering hypothermia as a treatment option in patients who are not eligible for surgical intervention (*weak recommendation, low quality of evidence*).

If hypothermia is considered, the authors suggest a target temperature of 33° to 36° Celsius for duration of 24 to 72 hours (*weak recommendation, low quality of evidence*).

The authors suggest maintaining normal core body temperature (*weak recommendation, very low quality of evidence*).

#### Head Position

What is the optimal head position in patients with LHI?

#### Recommendation

The authors suggest a horizontal body position in most patients with LHI. However in patients with increased ICP, they suggest a 30° backrest elevation (*weak recommendation, very low quality of evidence*).

#### Osmotic Therapy

Does osmotic therapy effectively treat brain edema and improve outcome in LHI?

What are the potential complications associated with the use of these agents?

#### Recommendations

The authors recommend using mannitol and hypertonic saline for reducing brain edema and tissue shifts in LHI only when there is clinical evidence of cerebral edema (*strong recommendation,*

*moderate quality of evidence*).

The authors suggest using osmolar gap instead of serum osmolality to guide mannitol dosing and treatment duration (*weak recommendation, low quality of evidence*).

Hypertonic saline dosing should be guided by serum osmolality and serum sodium (*strong recommendation, moderate quality of evidence*).

The authors recommend using mannitol cautiously in patients with acute renal impairment (*strong recommendation, moderate quality of evidence*).

The authors recommend using hypertonic saline cautiously in patients with volume overload states (i.e., heart failure, cirrhosis, etc.) since this agent will expand intravascular volume (*strong recommendation, high quality of evidence*).

### Neuroimaging by Computed Tomography (CT) and Magnetic Resonance Imaging (MRI)

Can neuroimaging by CT or MRI predict neurological deterioration and "malignant" course after LHI?

#### Recommendation

The authors recommend using early changes on CT and MRI to predict malignant edema after LHI (*strong recommendation, low quality of evidence*).

### Ultrasound

What is the value of transcranial Doppler (TCD) and transcranial color-coded duplex (TCCS) sonography for the prediction of malignant course after LHI?

#### Recommendation

The authors suggest using TCCS as a complementary test to predict malignant course and possibly as a primary test if the patient is too unstable to be transferred outside the ICU for neuroimaging (*weak recommendation, low quality of evidence*).

### Evoked Potentials

Can evoked potentials be used to predict malignant course after large hemispheric stroke?

#### Recommendation

The authors suggest considering brainstem auditory evoked potentials (BAEPs) as a complementary method to predict malignant course within the first 24 h after middle cerebral artery (MCA) infarction, particularly in patients too unstable to be transported to neuroimaging (*weak recommendation, very low quality of evidence*).

### Electroencephalography (EEG)

Can EEG predict a malignant course after LHI?

Is there a utility for continuous EEG monitoring in patients with LHI?

#### Recommendations

The authors suggest considering EEG in the first 24 h after stroke to assist with predicting clinical course in LHI (*weak recommendation, very low quality of evidence*).

The authors suggest that continuous and quantitative EEG represent a promising non-invasive monitoring technique and a tool for estimation of prognosis after LHI that might be useful in the future pending further study (*weak recommendation, very low quality of evidence*).

### Invasive Multimodal Monitoring

Can invasive multimodal monitoring (ICP, microdialysis, brain tissue oxygen [ptiO<sub>2</sub>]) predict malignant course after LHI?

What is the value of invasive multimodal monitoring in preventing secondary complications after

LHI?

## Recommendation

Invasive multimodal monitoring has not been sufficiently studied, and therefore cannot be recommended in the routine management of LHI (*weak recommendation, low quality of evidence*).

## Surgical Management

Should decompressive hemicraniectomy (DHC) be offered to patients with LHI?

What are the selection criteria for DHC in LHI?

What is the optimal timing and size for DHC?

Should age and hemispheric dominance play a role in the decision to offer DHC to LHI patients?

Should temporal lobectomy or duraplasty be offered as an adjunct therapy to DHC?

## Recommendations

The authors recommend DHC as a potential therapy to improve survival after LHI regardless of patient age (*strong recommendation, high quality of evidence*).

In patients older than 60 years, the authors recommend taking in consideration patients and family wishes, since in this age group, DHC can reduce mortality rate but with a higher likelihood of being severely disabled (*strong recommendation, moderate quality of evidence*).

There is currently insufficient data to recommend against DHC in LHI patients based on hemispheric dominance (*strong recommendation, low quality of evidence*).

To achieve the best neurological outcome, the authors recommend performing DHC within 24 to 48 h hours of symptom onset and prior to any herniation symptoms (*strong recommendation, moderate quality of evidence*).

The authors recommend a size of 12 cm as an absolute minimum for DHC. Larger sizes of 14 to 16 cm seem to be associated with better outcomes (*strong recommendation, moderate quality of evidence*).

The authors suggest that lobectomy or duraplasty should only be considered as an individualized treatment option (*weak recommendation, low quality of evidence*).

The authors suggest that the resection of the temporal muscle should only be considered as an individualized treatment option (*weak recommendation, low quality of evidence*).

## Ethical Considerations

Is the reduction of mortality after DHC achieved at the expense of functional dependency?

Is modified Rankin scale (mRS) score of 4 considered a desirable outcome after LHI?

## Recommendation

The authors suggest that the decision to perform DHC should depend on values and preferences of patients and relatives regarding survival and dependency (*weak recommendation, low quality of evidence*).

## Quality of Life (QoL)

Is survival after LHI associated with good QoL?

## Recommendation

The authors suggest that future research use QoL as an outcome measure in LHI patients (*weak recommendation, low quality of evidence*).

## Definitions

Grading of Recommendations Assessment, Development and Evaluation (GRADE) Criteria for Quality of Evidence

Quality of Evidence	Description
High	The authors are very confident that the true effect lies close to that of the estimate of the effect.
Moderate	The authors are moderately confident in the effect estimate. The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low	The authors' confidence in the effect estimate is limited. The true effect may be substantially different from the estimate of the effect.
Very Low	The authors have very little confidence in the effect estimate. The true effect is likely to be substantially different from the estimate of the effect.

#### Strength of Recommendation

Strength of Recommendation	Description
Strong	The desirable effects of an intervention clearly outweigh the undesirable effects, or clearly do not.
Weak	The risks and benefits of an intervention are less certain—either because of low quality evidence or because evidence suggests that desirable and undesirable effects are closely balanced.

## Clinical Algorithm(s)

None provided

## Scope

## Disease/Condition(s)

Large hemispheric infarction (LHI), also known as malignant middle cerebral infarction

## Guideline Category

Evaluation

Management

Prevention

Risk Assessment

Treatment

## Clinical Specialty

Critical Care

Emergency Medicine

Neurological Surgery

Neurology

# Intended Users

Advanced Practice Nurses

Allied Health Personnel

Emergency Medical Technicians/Paramedics

Hospitals

Nurses

Physician Assistants

Physicians

## Guideline Objective(s)

To provide evidence-based recommendations for the critical care management of patients following large hemispheric infarction (LHI)

## Target Population

Adult patients with large hemispheric infarction (LHI)

## Interventions and Practices Considered

1. Airway management
  - Intubation
  - Extubation
  - Tracheostomy
2. Rescue hyperventilation
3. Analgesia and sedation
4. Dysphagia screening
5. Nasogastric tube placement
6. Placement of a percutaneous endoscopic gastrostomy (PEG) tube
7. Glucose control: avoidance of hypoglycemia and hyperglycemia
8. Hemoglobin control
9. Deep venous thrombosis prophylaxis
  - Early mobilization
  - Intermittent pneumatic compression (IPC)
  - Low-molecular-weight heparin
10. Anticoagulation
11. Blood pressure management
12. Temperature control (hypothermia, normothermia)
13. Head positioning
14. Osmotic therapy (mannitol and hypertonic saline)
15. Neuroimaging by computed tomography (CT) and magnetic resonance imaging (MRI)
16. Prediction of malignant course
  - Transcranial Doppler (TCD) and transcranial color-coded duplex (TCCS) sonography
  - Brainstem auditory evoked potentials (BAEPs)
  - Electroencephalography (EEG) (continuous and quantitative)
17. Surgical management
  - Decompressive hemicraniectomy (DHC)
  - Lobectomy

- Duraplasty
- Resection of the temporal muscle

## 18. Ethical considerations

Note: The following were considered but not recommended: prophylactic hyperventilation, routine use of daily wake-up trials, intravenous sugar solutions, compression stockings, steroids, barbiturates, invasive multimodal monitoring (intracranial pressure [ICP], microdialysis, brain tissue oxygen [ptiO<sub>2</sub>]) (not recommended).

## Major Outcomes Considered

- Mortality
- Quality of life/neurological outcomes
- National Institute of Health Stroke Scale (NIHSS) scores
- Feasibility and safety of endovascular cooling
- Frequency of intracranial pressure (ICP) crises
- Rate of deep vein thrombosis (DVT)
- Utility of diagnostic tests

## Methodology

### Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

### Description of Methods Used to Collect/Select the Evidence

Subgroup: Brain Edema Therapy of Large Hemispheric Infarction (LHI)

The guideline authors performed a search of Medline/PUBMED, EMBASE, Cochrane, CINAHL and found 4,695 articles.

#### Inclusion Criteria

Publication date from 1990/01/01 to 2012/12/31  
 Type of studies: Humans; Clinical Trials (phase I, phase II, phase III, and phase IV); Classical Articles; Comparative Studies; Controlled Clinical Trials; Evaluation Studies; Meta-Analysis; Multicenter Studies; Randomized Controlled Trials; Systematic Reviews, Validation Studies  
 Language: English

#### Exclusion Criteria

Case reports (less than 5 patients)  
 Reviews  
 Stroke size unclear  
 Non-large hemispheric infarction (LHI) populations or mixed stroke size population

After applying the inclusion and exclusion criteria and eliminating duplicates and non-English articles, the authors hand searched the titles and abstracts and retained 185 studies, which underwent full inspection. After the studies were fully inspected, methods ascertained, and results evaluated, 156 studies were eliminated using the criteria established above, retaining only 30 manuscripts.

Subgroup: Monitoring (Intracranial Pressure [ICP], Microdialysis, Cerebral Blood Flow [CBF], Brain Tissue

## Oxygen [ptiO<sub>2</sub>]) in Large Middle Cerebral Artery (MCA) Infarction

Literature searches were performed in PubMed.

### Inclusion Criteria

Studies on monitoring modalities in patients with large hemispheric infarction  
Different techniques and approaches to assess ICP, CBF, brain tissue oxygenation, metabolic parameters (e.g., ultrasonography, imaging, positron emission tomography [PET], single-photon emission computed tomography [SPECT], invasive techniques, near-infrared spectroscopy [NIRS], etc.), or pathological changes in electroencephalography (EEG), somatosensory evoked potentials (SSEP), auditory evoked potentials (AEP)  
Sample size minimum (4-5) patients

### Exclusion Criteria

Other diagnostic categories (transient brain injury [TBI], intracerebral hemorrhage [ICH]), or <50% MCA territory affected  
Case reports, too small patient number  
Studies not focusing on monitoring, or monitoring not playing substantial role in the study design  
Published before 01 Jan 1990  
Language other than English, German, French or Spanish

The initial search yielded 1367 articles. After review of the titles 227 articles were selected for further evaluation. After reading the abstracts, 73 articles remained for full review. After reading those articles in full text, 46 papers remained. The reference lists of the articles and the publications lists (as accessible on PubMed) of the authors of those papers were additionally screened for missing articles.

### Subgroup: Predictors of Poor Outcome after Malignant MCA Stroke

PubMed was searched from 8/9/12 to 8/15/12 and covered publication dates from 1990/01/01 to 2012/12/31. Hand searches were carried out from 8/25/12 to 9/25/12.

A total of 41 articles were identified for further review.

## Number of Source Documents

### Subgroup: Brain Edema Therapy of Large Hemispheric Infarction (LHI)

A total of 30 manuscripts were retained.

### Subgroup: Monitoring (Intracranial Pressure [ICP], Microdialysis, Cerebral Blood Flow [CBF], Brain Tissue Oxygen [ptiO<sub>2</sub>]) in Large Middle Cerebral Artery (MCA) Infarction

A total of 46 papers remained after full-text review.

### Subgroup: Predictors of Poor Outcome after Malignant MCA Stroke

A total of 41 articles were identified for further review.

## Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

## Rating Scheme for the Strength of the Evidence

Grading of Recommendations Assessment, Development and Evaluation (GRADE) Criteria for Quality of Evidence

Quality of Evidence	Description
High	The authors are very confident that the true effect lies close to that of the estimate of the effect.
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Low	The authors' confidence in the effect estimate is limited. The true effect may be substantially different from the estimate of the effect.
Very Low	The authors have very little confidence in the effect estimate. The true effect is likely to be substantially different from the estimate of the effect.

## Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

## Description of the Methods Used to Analyze the Evidence

Each subtopic-related expert panel performed a critical literature review and summarized the findings in tables.

For each clinical question, the panel assessed the quality of the data and developed recommendations using the Grading of Recommendation Assessment, Development and Evaluation (GRADE) system. The panel graded the quality of the evidence as very low, low, moderate, or high. The panel considered quality of evidence in terms of the likelihood that the further research would change their level of confidence in the estimate of effect for an intervention (see the "Rating Scheme for the Strength of the Evidence" field).

## Methods Used to Formulate the Recommendations

Expert Consensus (Consensus Development Conference)

## Description of Methods Used to Formulate the Recommendations

A committee identified topics of interest based on clinical decision points in the critical care management of large hemispheric infarction (LHI) patients. The committee recruited European and North American experts from the fields of neurosurgery, neurocritical care, neurology, interventional neuroradiology, and neuroanesthesiology, and divided them into different subtopic-related panels based on expertise. Each panel performed a critical literature review and summarized the findings in tables; draft recommendations were prepared based on this data. Before the conference, this draft information was distributed to the larger group of conference participants.

For each clinical question, the panel assessed the quality of the data and developed recommendations using the Grading of Recommendation Assessment, Development and Evaluation (GRADE) system. The panel graded the quality of the evidence as very low, low, moderate, or high (see the "Rating Scheme for the Strength of the Evidence" field). The panel considered quality of evidence in terms of the likelihood that the further research would change their level of confidence in the estimate of effect for an intervention.

The GRADE system classifies recommendations as strong or weak, according to the quality of evidence,

the balance between risks and benefits, patient preferences, and cost considerations (see the "Rating Scheme for the Strength of the Recommendations" field). Evaluating each of these components individually and explicitly is a defining feature of this guideline system. One advantage of GRADE is that it allows for strong recommendations in the setting of lower quality evidence, as long as there are other mitigating factors.

At the Neurocritical Care Society (NCS) annual meeting in October 2012, each panel member presented a summary of the data and recommendations to the group. The committee met again in Mannheim, Germany on January 23–26, 2013 during the German Society for Neuro-Intensive Care and Emergency Medicine annual meeting. The committee reviewed key studies and the recommendations made by individual panel members. The final questions were reviewed at the conference and feedback was obtained from a larger auditorium of interdisciplinary neurocritical care practitioners.

## Rating Scheme for the Strength of the Recommendations

### Strength of Recommendation

Strength of Recommendation	Description
Strong	The desirable effects of an intervention clearly outweigh the undesirable effects, or clearly do not.
Weak	The risks and benefits of an intervention are less certain—either because of low quality evidence or because evidence suggests that desirable and undesirable effects are closely balanced.

## Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

## Method of Guideline Validation

Not stated

## Description of Method of Guideline Validation

Not applicable

## Evidence Supporting the Recommendations

### Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

## Benefits/Harms of Implementing the Guideline Recommendations

### Potential Benefits

Appropriate critical care management of large hemispheric infarction that addresses specific questions that intensivists deal with on a day-to-day basis on rounds

## Potential Harms

- There is a risk of bleeding from heparin and warfarin.
- Although some studies found hypothermia to be generally safe, hypotension, hematologic effects, and infections were common side effects. It is also important to keep in mind the potential side effects of hypothermia such as pneumonia and coagulopathy.
- Mannitol should be used cautiously in patients with acute renal impairment.
- Hypertonic saline should be used cautiously in patients with volume overload states (i.e., heart failure, cirrhosis, etc.) since this agent will expand intravascular volume.
- Computed tomography (CT) scans require patient transportation and expose the patient to radiation.
- Insufficient bone window may represent a limitation of ultrasound-based monitoring in some patients. Another difficulty of sonography is that a reliable ultrasound examination usually requires a skilled and experienced examiner.
- The decision about whether or not to perform depressive hemicraniectomy (DHC) must also address its known complications, such as anesthetic risks, surgical risks (pain, infection, bleeding, and extra-axial fluid collections), the "syndrome of the trephined" (headache, seizures, and worsening of neurological deficit), higher rates of hydrocephalus, and the risks of cranioplasty (bleeding, infection). Since large hemispheric infarction (LHI) patients often have many medical co-morbidities, these risks can be substantial. Furthermore, the costs of DHC must be acknowledged, including the direct costs of the procedures and the prolonged hospitalization, as well as the costs of chronic care associated with functional dependency in a patient who might have otherwise died soon after their infarction.
- The concern of many clinicians has been that a reduction in mortality might be outweighed by a major disability in most survivors, leaving them severely disabled and facing a life of dependency, pain, and hopelessness. Therefore, the choice of performing DHC should hinge on the patient's willingness to accept survival with some degree of disability.
- Clinicians should avoid unnecessary or excessive analgesia and sedation, as this might lead to hypotension, immunosuppression, thromboembolic events, prolonged coma and ventilation, and other agent-specific side effects.

## Qualifying Statements

### Qualifying Statements

- The International Consensus Conference on Critical Care Management of Patients Following Large Hemispheric Infarct (LHI) was designed to help develop recommendations for treating LHI patients. One significant challenge the reviewers faced was the paucity of large clinical trials addressing important clinical management questions. The Grading of Recommendation Assessment, Development and Evaluation (GRADE) system allowed the panels to make recommendations not based only on the quality of the evidence but to also incorporate the factors such as risk benefit ratio, patient values and preferences, and resource consideration.
- It was clear that additional research is needed across the continuum of LHI patient care. Unfortunately, this type of clinical research could be difficult to execute given the complexity and variability of these patients. In the meantime, these guidelines can be used as a road map in treating patients with LHI. It should be noted that all guidelines need to be considered in the context of regional needs and resources, particularly when it comes to weak recommendations. The panel encourages guideline users to consider the nuances of the evidence presented as they implement these recommendations in their own practice. As the evidence grows, these recommendations will need to be reviewed accordingly.

# Implementation of the Guideline

## Description of Implementation Strategy

An implementation strategy was not provided.

## Implementation Tools

Slide Presentation

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

## Institute of Medicine (IOM) National Healthcare Quality Report Categories

### IOM Care Need

Getting Better

### IOM Domain

Effectiveness

Patient-centeredness

Timeliness

## Identifying Information and Availability

### Bibliographic Source(s)

Torbey MT, BÃ¶sel J, Rhoney DH, Rincon F, Staykov D, Amar AP, Varelas PN, JÃ¼ttler E, Olson D, Huttner HB, Zweckberger K, Sheth KN, Dohmen C, Brambrink AM, Mayer SA, Zaidat OO, Hacke W, Schwab S. Evidence-based guidelines for the management of large hemispheric infarction: a statement for health care professionals from the Neurocritical Care Society and the German Society for Neuro-intensive Care and Emergency Medicine. *Neurocrit Care*. 2015 Feb;22(1):146-64. [172 references] [PubMed](#)

### Adaptation

Not applicable: The guideline was not adapted from another source.

### Date Released

2015 Feb

## Guideline Developer(s)

German Society for Neuro-Intensive Care and Emergency Medicine - Medical Specialty Society

Neurocritical Care Society - Medical Specialty Society

## Source(s) of Funding

Neurocritical Care Society

## Guideline Committee

Management of Large Hemispheric Infarction Guideline Committee

## Composition of Group That Authored the Guideline

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## Financial Disclosures/Conflicts of Interest

### Conflict of Interest

Michel T Torbey has received speaker honorarium from Genentech, support from the National Institutes of Health (NIH). Julian Bösel has received speaker honoraria and travel support from Covidien, Sedana Medical, and Orion Pharma. Denise H. Rhoney declares that she has no conflict of interest. Fred Rincon declares that he has research and salary support from the American Heart Association (12CRP12050342). He has also received consultant fees from Bard Medical Inc. Dimitre Staykov declares that he has no conflict of interest. Arun Amar declares that he has no conflict of interest. Panayiotis Varelas has participated in Advisory Boards of Pfizer and UCB. Eric Jüttler has received a speaker's honorarium from BMS/Pfizer, a consultant's honorarium from Boehringer Ingelheim, and a research grant from the German Research Foundation (Deutsche Forschungsgemeinschaft). DaiWai Olson declares that he has no conflict of interest. Hagen B. Huttner declares that he has no conflict of interest. Klaus Zweckberger declares that he has no conflict of interest. Kevin N Sheth declares that he received research support from Remedy

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## Guideline Endorser(s)

American Association of Neurological Surgeons - Medical Specialty Society

American Heart Association - Professional Association

American Stroke Association - Disease Specific Society

Congress of Neurological Surgeons - Professional Association

## Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

## Guideline Availability

Available from the [Neurocritical Care Journal Web site](#) .

## Availability of Companion Documents

The following is available:

Evidence-based guidelines for the management of large hemispheric infarction (LHI). Slide kit. 2015 Feb. 30 p. Available from the [Neurocritical Care Society Web site](#) .

## Patient Resources

None available

## NGC Status

This NGC summary was completed by ECRI Institute on January 31, 2017. The information was verified by the guideline developer on March 20, 2017.

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